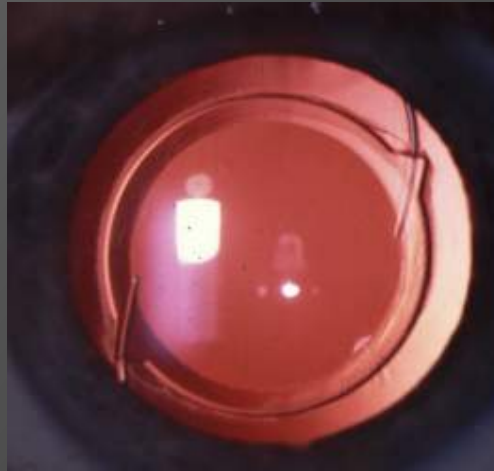


# Pseudophakic Dysphotopsias



**SAMUEL MASKET MD**  
**CLINICAL PROFESSOR – UCLA**  
**LOS ANGELES**

**RELEVANT DISCLOSURE – US PATENT IOL DESIGN**

# The Dysphotopsias

Subjective (Undesired) Optical Images  
Associated with **Otherwise Uncomplicated  
Cataract/IOL Surgery** – Photic Phenomena

- ⦿ Positive (PD) – light streaks, arcs, flashes, star bursts
- ⦿ Negative (ND) – temporal dark shadow
- ⦿ Multifocal (Diffractive) – halos, rings

# Incidence of Dysphotopsias

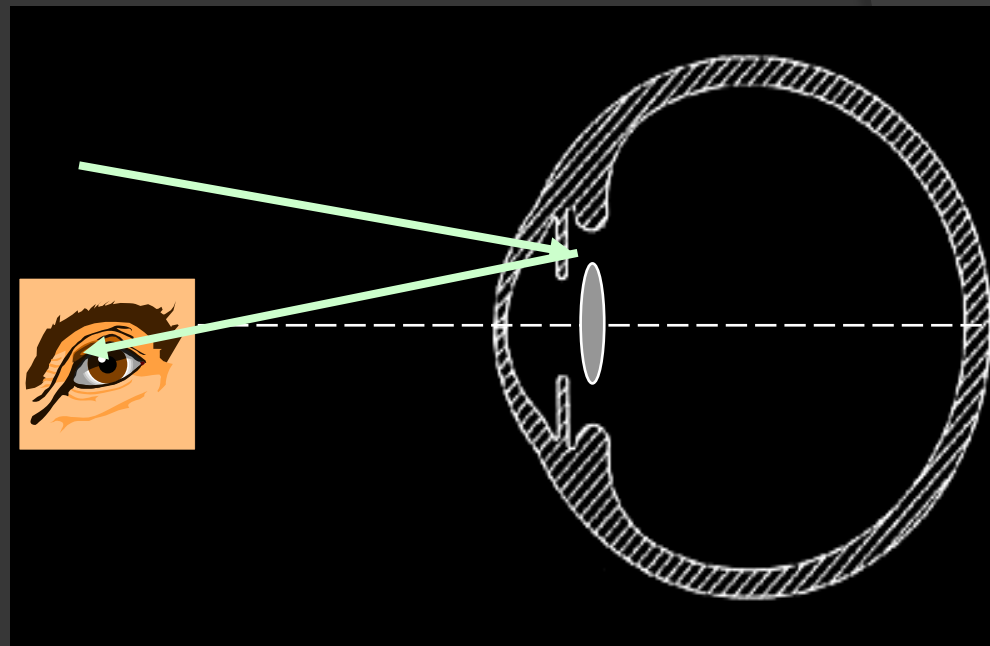
## Chief Cause of Dissatisfaction Following “Routine” Cataract Surgery – Olson

- Tester, et al (JCRS 2000) 49% overall ND/PD
- Bournas (Ophthalmologica 2007) 19.5% POD 1
- Osher (JCRS 2008) 15.2% POD1 3.2% 1 YR ND
- Sharma (ESCRS) 9.6% POD 1 1.6% POD 42 ND
- 30,000 – 100,000 New Pts/Yr

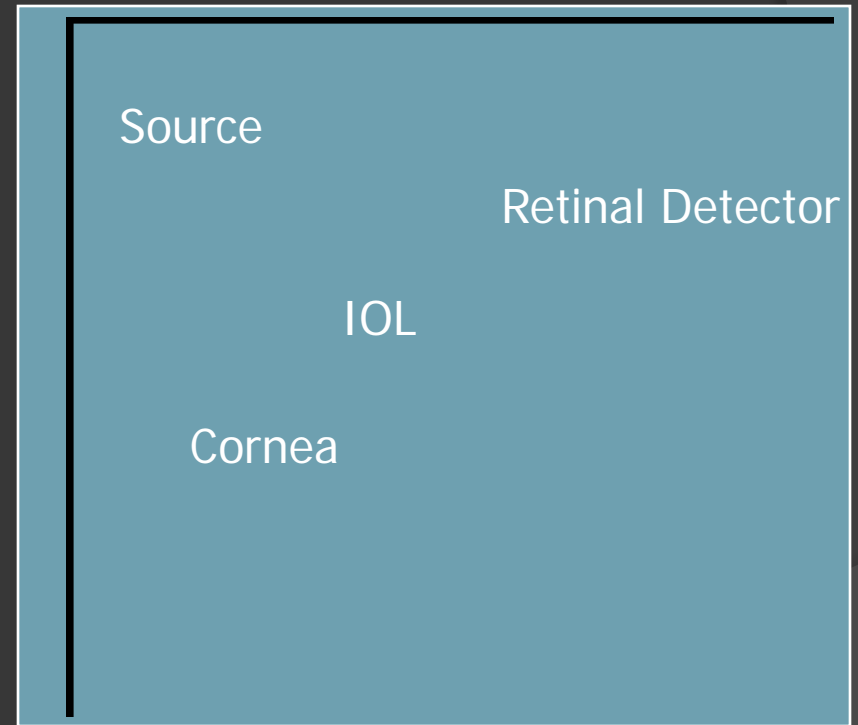
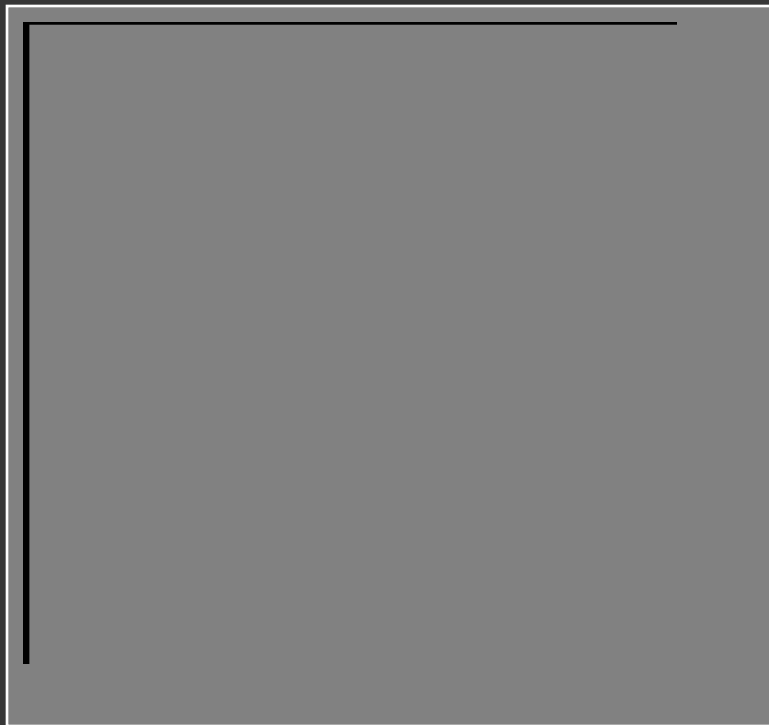
# Evaluating Dysphotopic Complaints

- There is NO objective test for clinical dysphotopsia
- Only subjective data available (PROs)
- Lab – Ray tracing analysis and Reflectometry of IOL
- Distinguished from Purkinje images, Maddox Rod Effect, and disabling glare

## Purkinje Image(s)

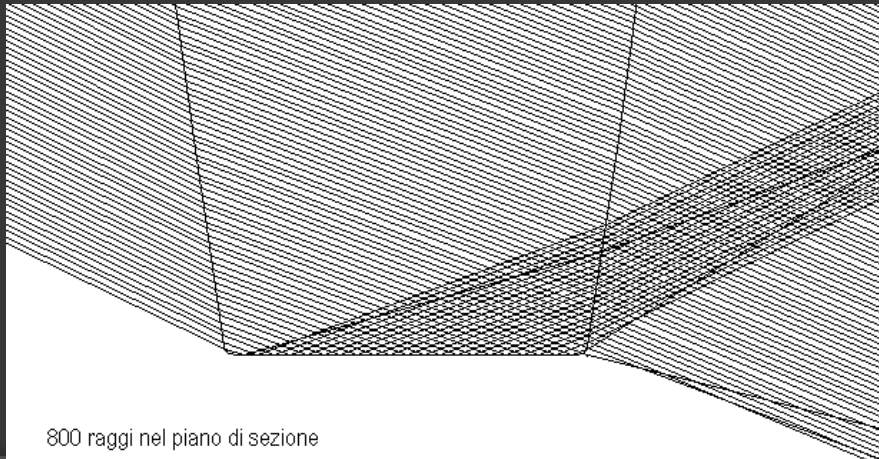
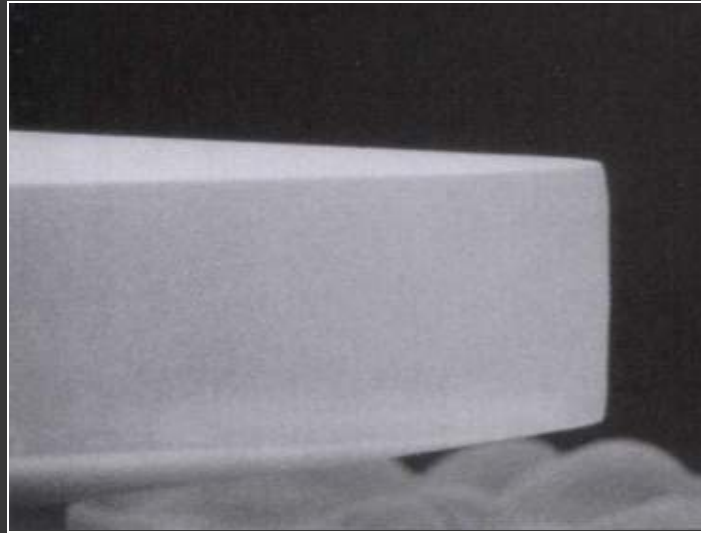


# Zemax Non-sequential Ray-Tracing Used to Analyze Edge Glare

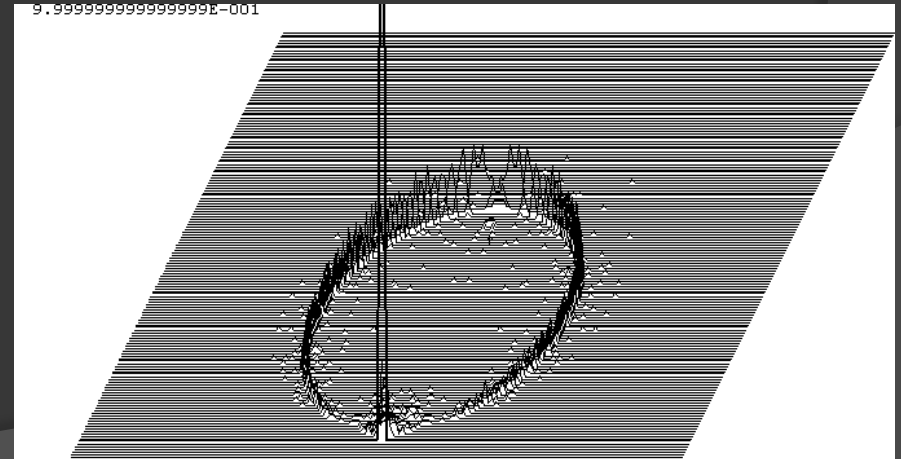


# Ray Tracing Analysis of Edge Types – Franchini

## JCRS 2/2003



800 raggi nel piano di sezione



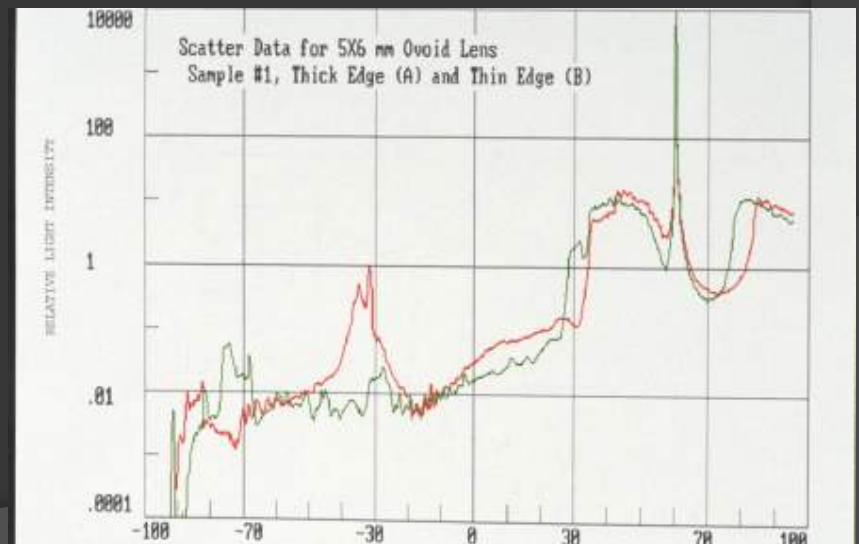
# Edge Glare with Oblique Light



# Edge Induced Dysphotopsia

Not reported until use  
of ovoid PC IOLs

Masket, et al JCRS 1993



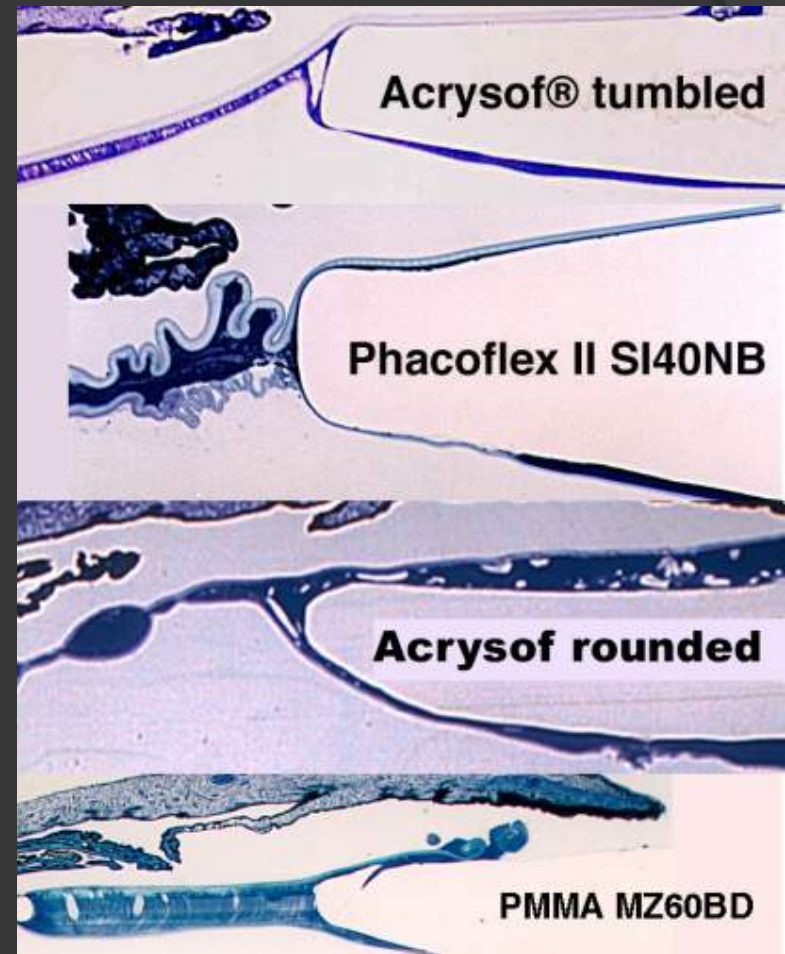
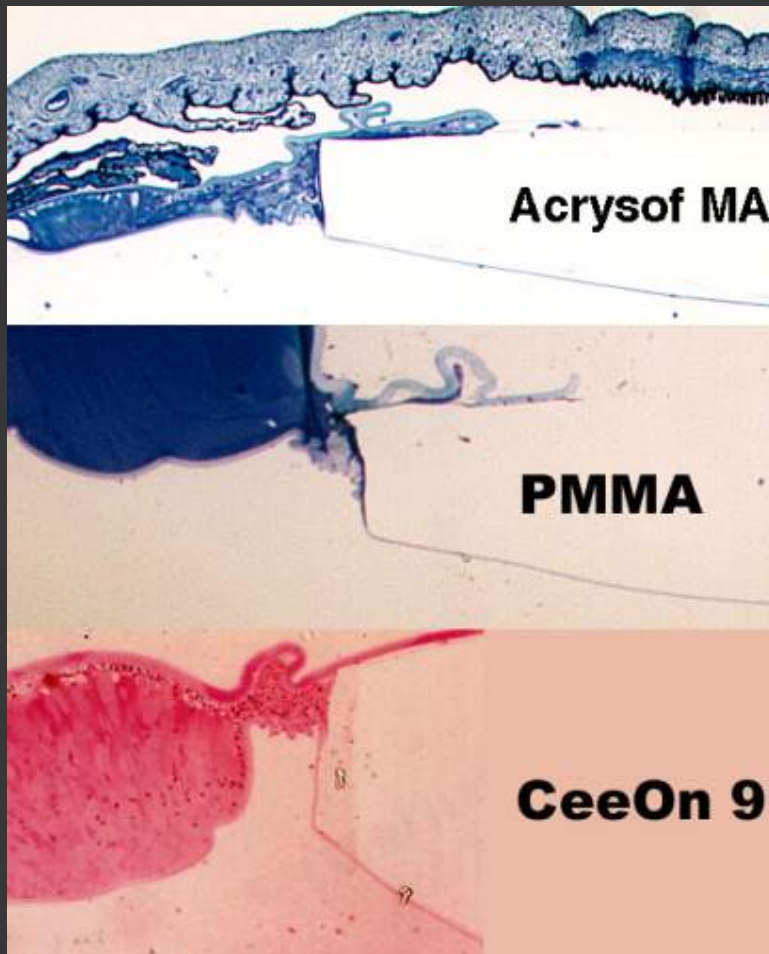


# IOLs, PCO, and Square Edges

Nishis' work established Square Edge design inducing non-continuous capsule bending as the most important IOL factor in retarding PCO, irrespective of IOL material.

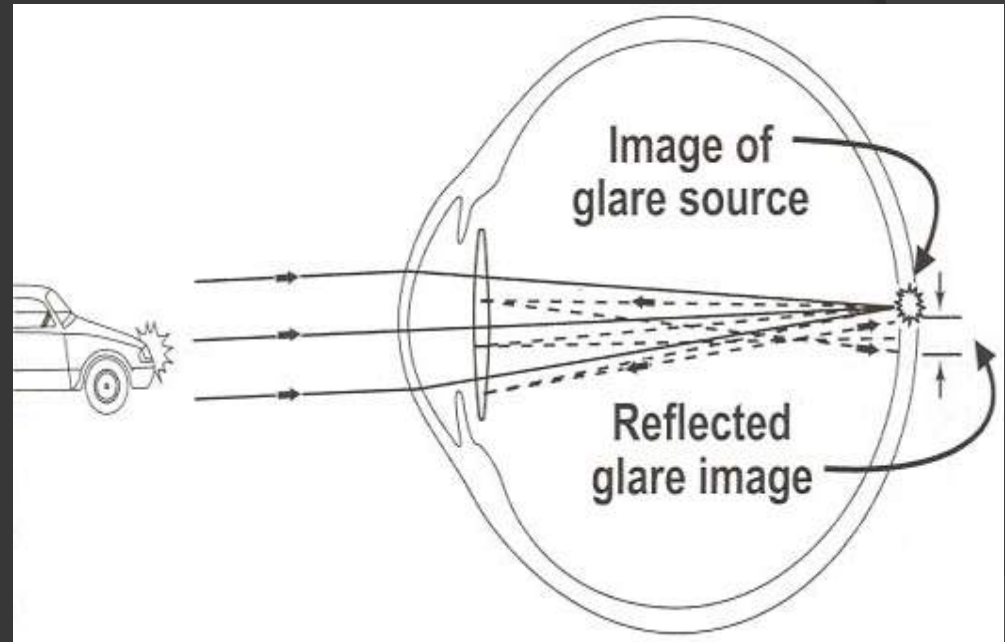


# Nishi and Nishi – JCRS Feb 2003



# What Causes Positive Dysphotopsia?

Erie et al (JCRS 2001, 2003) demonstrated that internal reflections of nearly axial light by the posterior aspect of the front surface of the IOL cause positive dysphotopsia. The flatter the lens radius of curvature and the higher the index of refraction of the material, the worse the condition.



# Industry Response to PD

- ⦿ Modify square edge – reduce thickness, anterior edge round
- ⦿ Leave IOL edge unpolished or frosted
- ⦿ Move more optical power to anterior IOL surface, less to posterior surface
- ⦿ Opt for materials with lower I/R
- ⦿ Reduce surface reflectivity? (albedo)

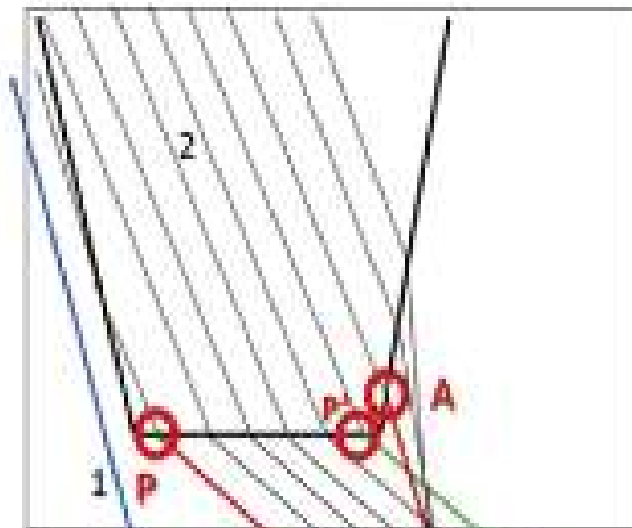
# Negative Dysphotopsia

- ◉ Less Understood
- ◉ Temporal Dark Arc
- ◉ Etiology Unclear
  - Holladay – “Enigmatic Penumbra” – IOL Edge
  - Masket & Fram – Relationship of IOL to capsule bag

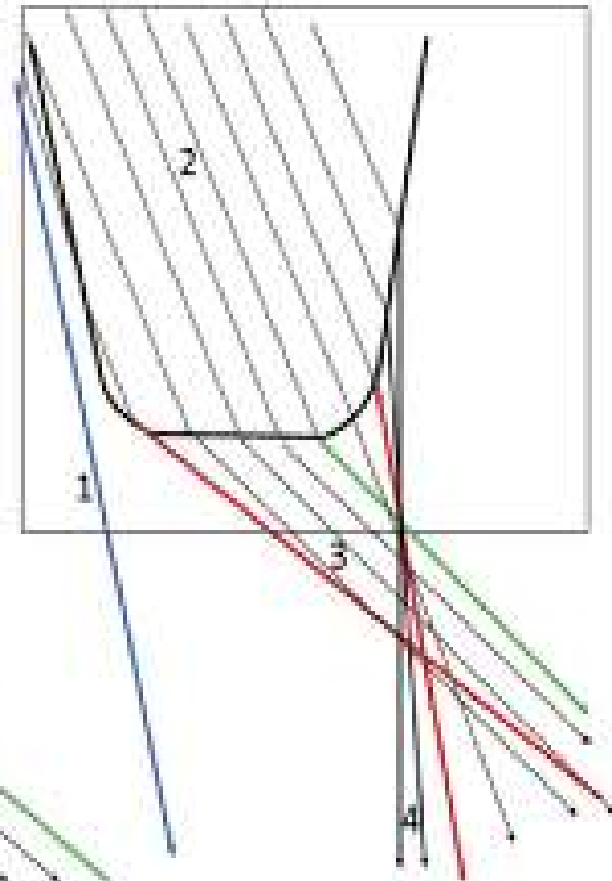


# Holladay, et al JCRS 7/2012

## Sharp Edge



## Round Edge



# Pseudophakic negative dysphotopsia: Surgical management and new theory of etiology

Samuel Masket, MD, Nicole R. Fram, MD

**PURPOSE:** To evaluate the benefit of various surgical methods to address pseudophakic negative dysphotopsia.

**SETTING:** Private practice, Los Angeles, California, USA.

**DESIGN:** Interventional case series.

**METHODS:** The following 4 surgical methods were used to treat pseudophakic negative dysphotopsia: piggyback intraocular lens (IOL) implantation, reverse optic iris suture fixation. Ultrasound biomicroscopy (UBM) was used to evaluate the anatomy. The primary outcome was partial or complete resolution of symptoms 3 months postoperatively.

## Journal of Biomedical Optics

SPIEDigitalLibrary.org/jbo

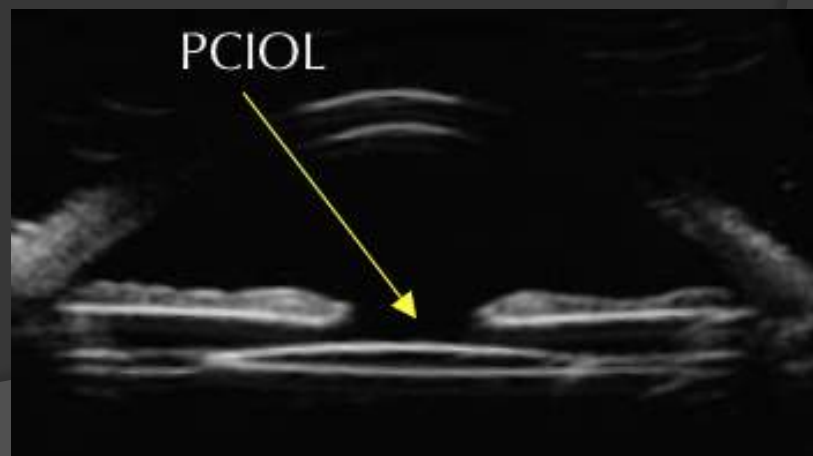
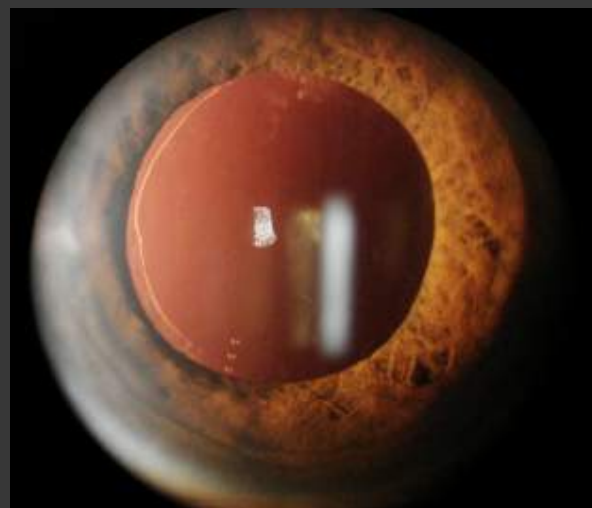
### Ray-tracing optical modeling of negative dysphotopsia

Xin Hong  
Yueai Liu  
Mutlu Karakelle  
Samuel Masket  
Nicole R. Fram



# Negative Dysphotopsia – Clinical Observations

- Associated with **incision in ANY location and ANY in the bag IOL**
- Stimulated by temporal light
- Only seen with “anatomically perfect surgery”
- Symptoms may be uni-ocular
- Symptoms abate with pupil dilation
- Not reported with **sulcus placed PC IOLs** or **AC IOLs**
- Posterior Chamber Depth Not a Factor





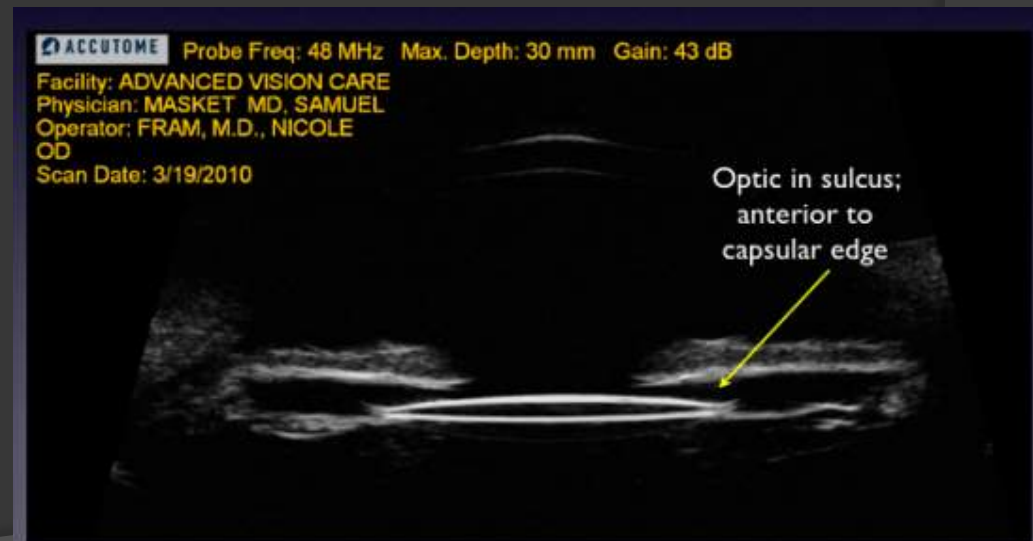
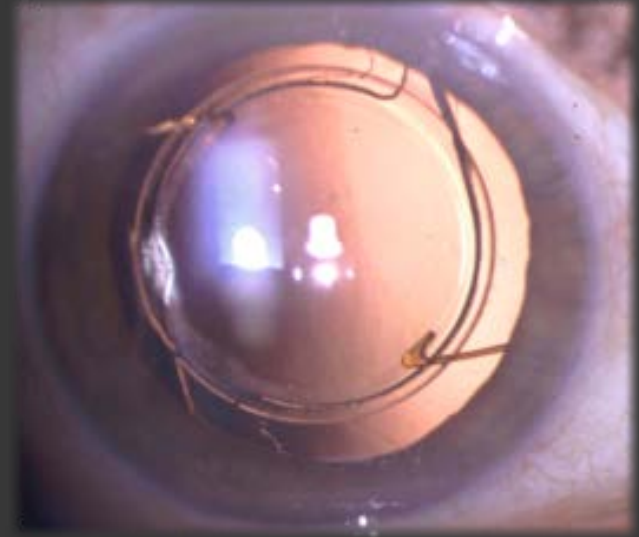
# Negative Dysphotopsia: Surgical Experience – 34 Eyes

“Piggyback” Low IOL power  
alleviated symptoms – 8/10

“Reverse Optic Capture”  
Primary –” prevented “  
symptoms 8/8\*  
Secondary 12/12

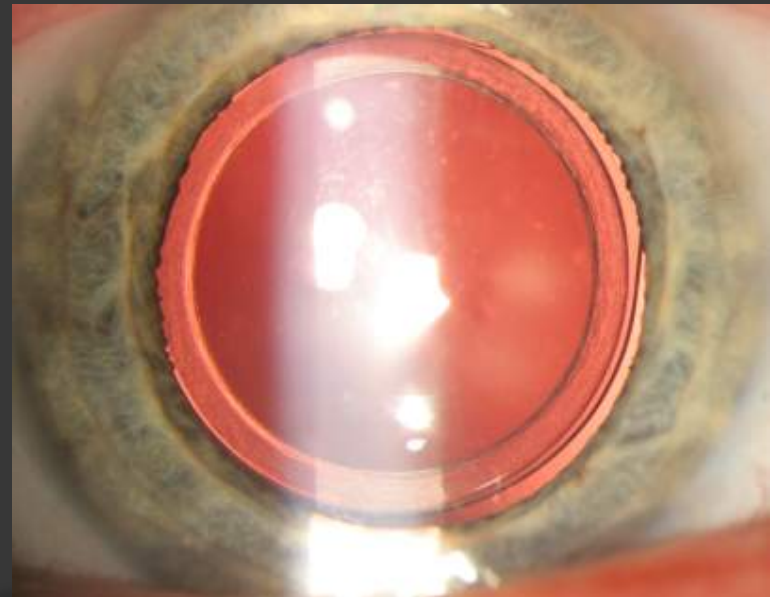
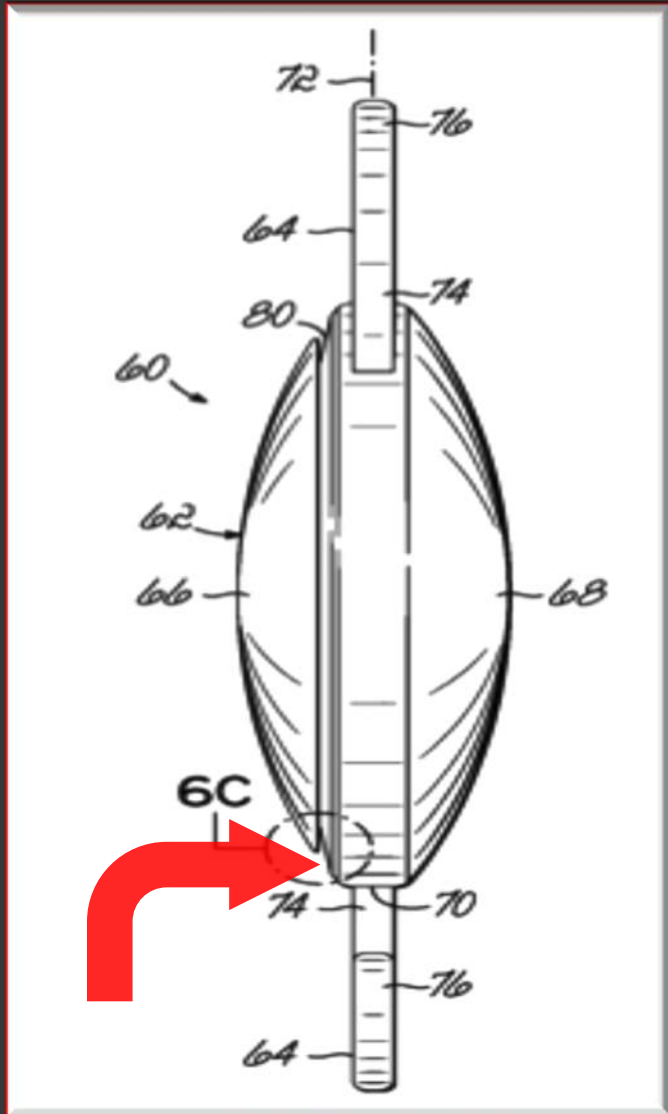
IOL Exchange – Bag to sulcus  
3/4

Overall benefit 31/34\* eyes

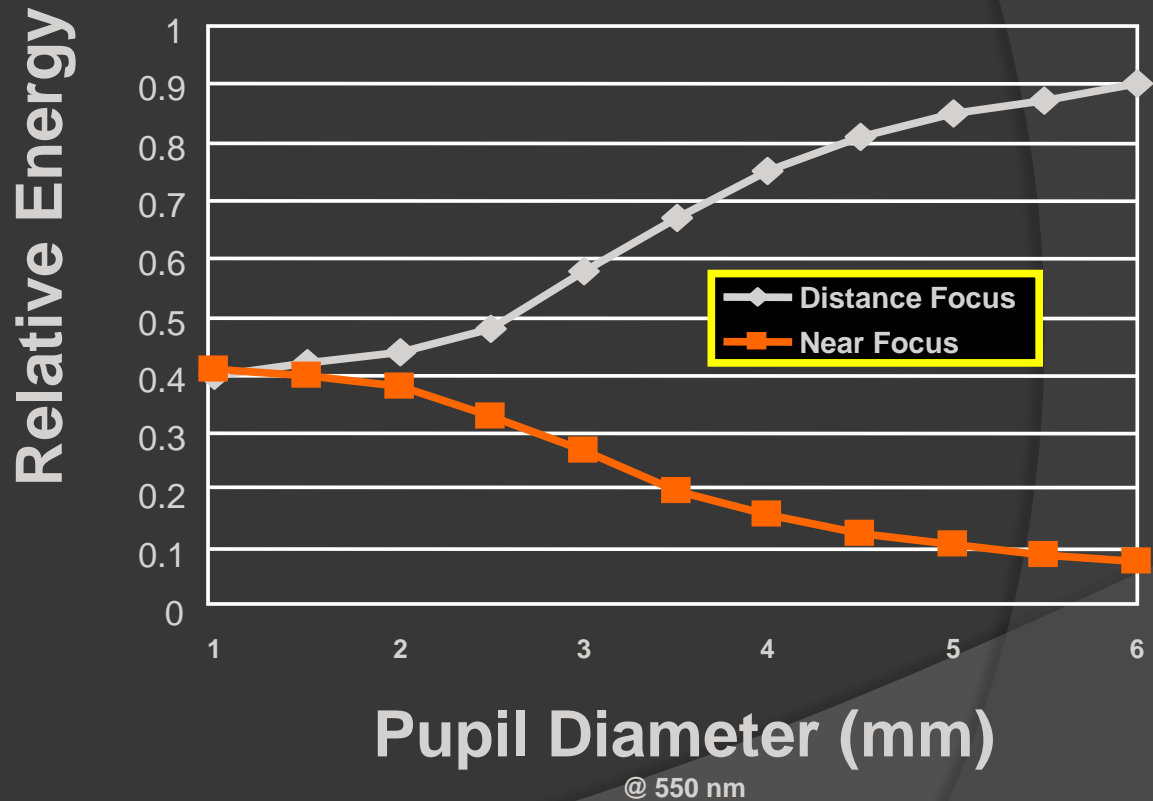


# Industry Response to ND

# Anti-Dysphotopic IOL



# Multifocal Dysphotopsia: Additive to Pseudophakic ND and PD



# Image Degradation by Astigmatism with Diffractive Multifocal IOLs

Cylinder 0 D

Cylinder 0.5D

Cylinder 1.0D



# Visual Disturbances

## 120-180 Days Post-Operative

None/Mild

Moderate

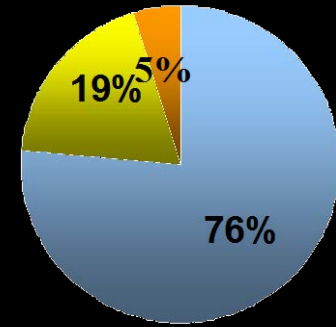
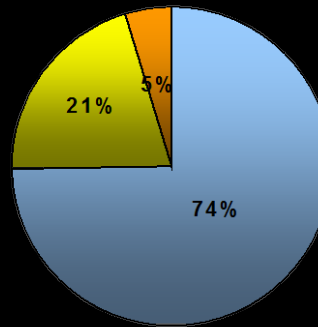
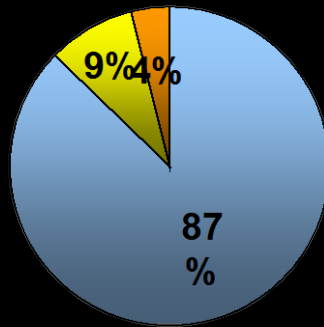
Severe

Night Vision  
Problems

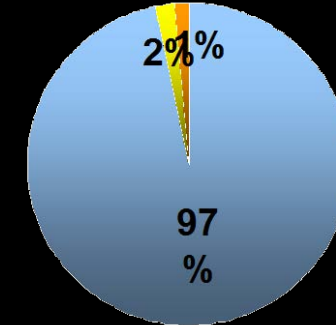
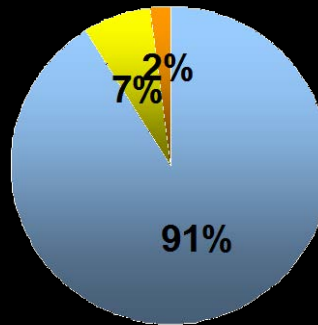
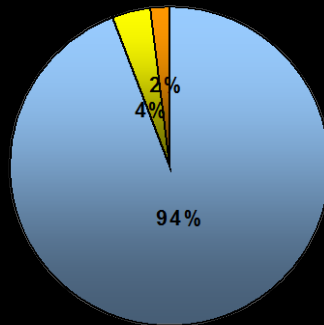
Glare

Halos

AcrySof®  
ReSTOR® IOL  
N=457



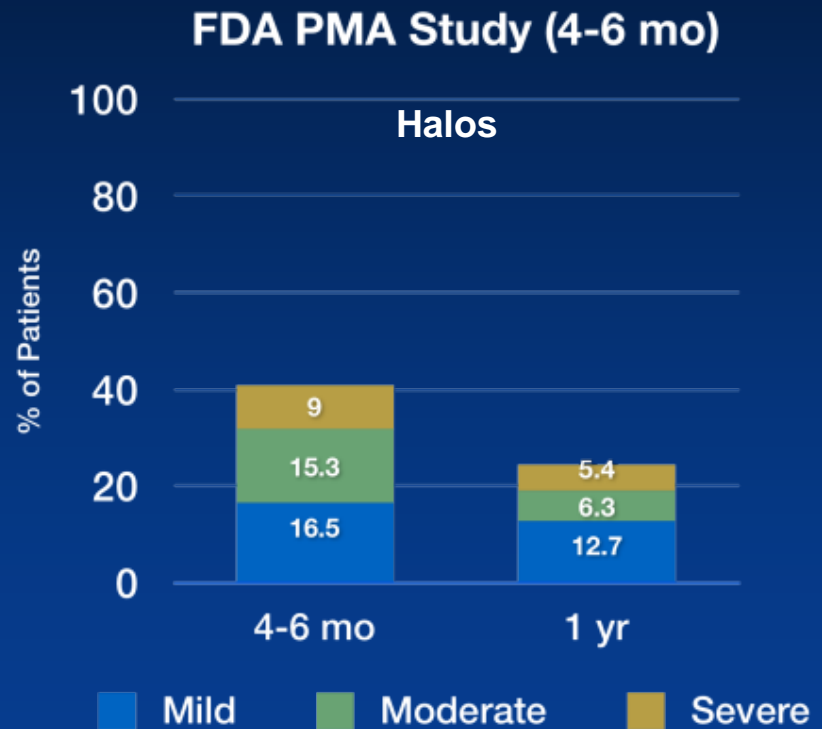
Monofocal  
Control  
N=156



# Side Effects

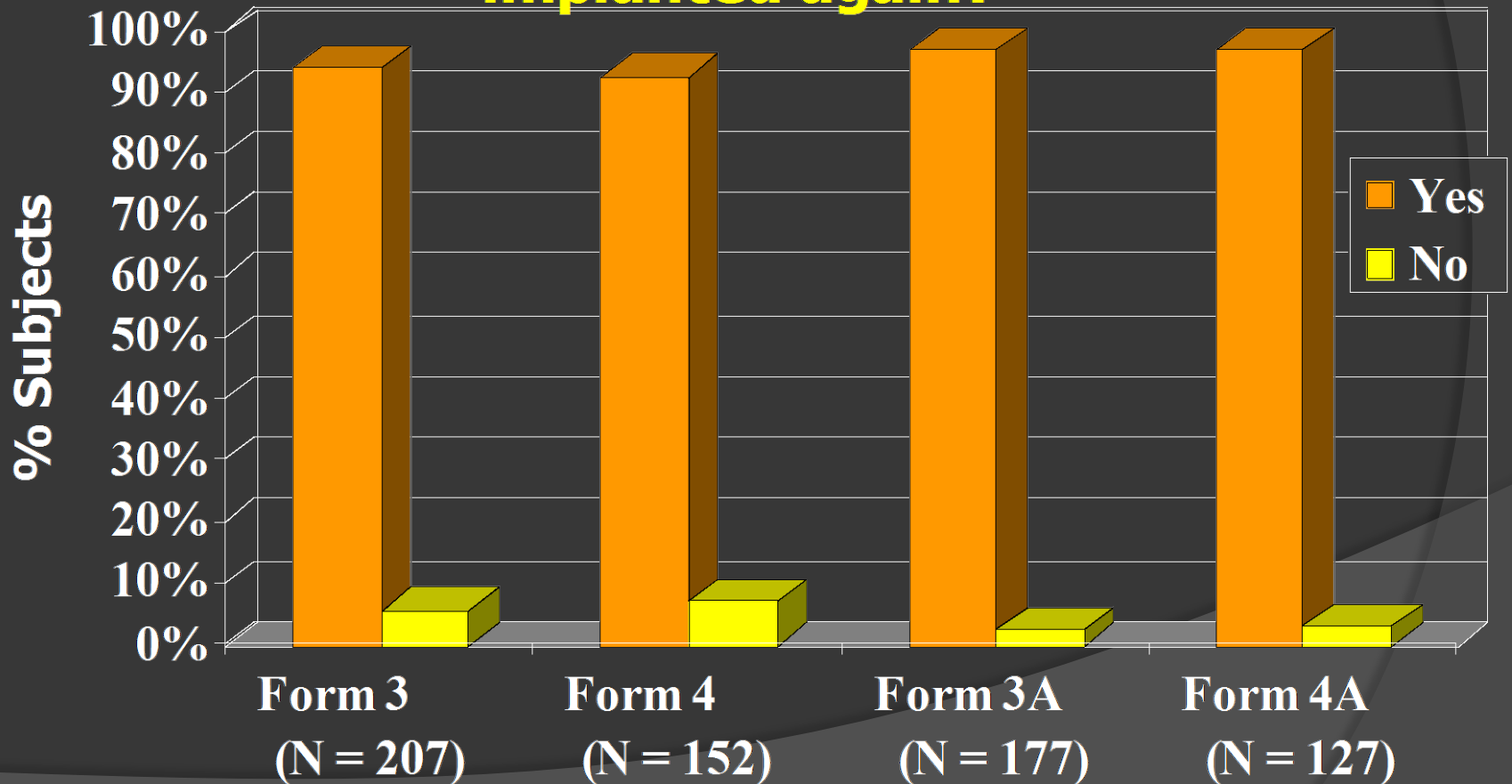
## Optical / Vision Symptoms

- Non-directed subject responses
  - “Are you having any difficulties with your eyes or vision”
- Halos most commonly reported
  - Most “mild” to “moderate”
  - Improved with time



# Patient Satisfaction

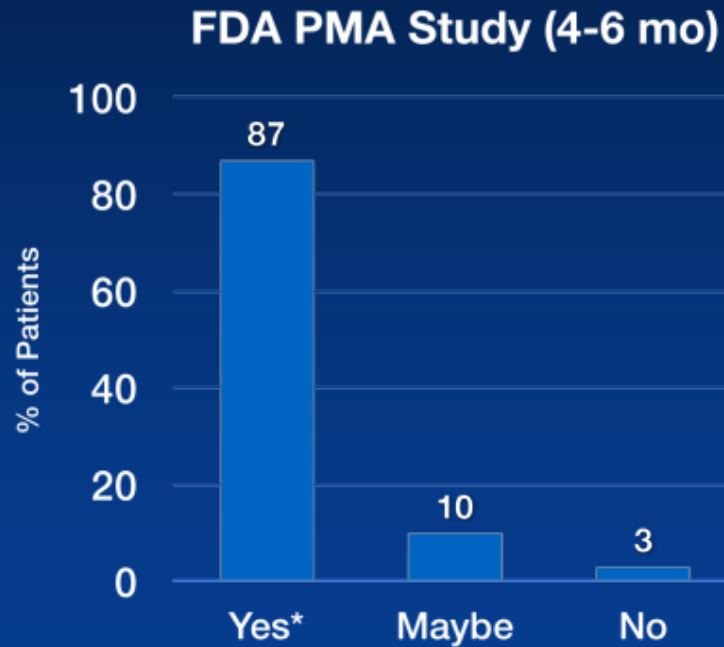
**Would you have the same intraocular lens implanted again?**





# Patient Questionnaire

If you had to undergo cataract surgery again, would you elect to have the same lens implanted?



\*Higher than monofocal control

# Dissatisfaction After Multifocal IOLs

De Vries, et al JCRS 2011; 37:859–865

- Retrospective chart review – 76 eyes
- Photoc phenomena – 38.2%
- Blurred VA – 94.7%
- Chief causes – ametropia, PCO, pupil
- Amenable to therapy – 84.2%
- IOL Exchange – 4.0%

# Summary

- Pseudophakic dysphotopsias (PD and ND) represent a meaningful burden
- Diffractive multifocal IOLs have additional photic side effects

